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US-A- 4 801 905

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Description**BACKGROUND OF THE INVENTION****Field of the Invention**

The present invention relates to a radar transponder which, on reception of a high frequency signal such as a microwave signal from a radar, responds to (synchronize with) the signal and transmits a high frequency response signal.

Description of the Prior Art

Fig. 1 is a circuit block diagram of a conventional radar transponder. Such transponder is known from EP-A-0 308 877. This document, however, falls under Article 54(3) EPC. In Fig. 1, reference numeral 1 is a receiving antenna, 2 a diode direct detector, 3 a video amplifier, 4 a control circuit, 5 a transmission gate circuit, 6 a sweep signal generator, 7 a microwave oscillator, 8 a transmitting antenna, and 16 a FET amplifier. In this case, the diode direct detector 2 and the FET amplifier 16 are integrated by a microwave integrated circuit (MIC).

Next, the operation will be described. A microwave signal received by the receiving antenna 1 coming from a radar is amplified by the FET amplifier 16, the amplified electric wave detected by the diode direct detector 2, the detected output is amplified by the video amplifier 3, and is sent to the control circuit 4. The control circuit 4 forms pulses for creating the transmission time of a radar transponder using an input video amplified signal and transfers the pulses to the transmission gate circuit 5. The transmission gate circuit 5 forms transmission gate pulses using the transferred output pulses from the control circuit, and the transmission gate pulses are input to the sweep signal generator 6 and the microwave oscillator 7. The sweep signal generator 6 generates saw-tooth voltage which wave form consists of a required number of saw-tooth pulses using the transmission gate pulses and transfers them to the microwave oscillator 7. The microwave oscillator 7 performs transmission for a fixed time set by the transmission gate pulses and performs frequency sweep in a regular frequency range using the saw-tooth output voltage. A frequency swept signal from the microwave oscillator 7 is propagated into the space by the transmitting antenna 8.

Since the conventional radar transponder is composed as above-described, unnecessary waveguide electromagnetic field modes are generated in a waveguide composed of antenna housing and MIC portion, and the unnecessary waveguide electromagnetic field modes interfere

with the FET amplifier 16. Thereby inherent performance of the FET amplifier 16 is not obtained. As a result, there is such a problem that the sufficient receiving sensibility is not obtained. There are also other problems, for example, one of them is that the performance of the MIC portion adjusted under the condition which the MIC portion is not connected to the antenna housing cannot be appear.

SUMMARY OF THE INVENTION

The present invention is devised to solve the above-mentioned problems and it is an object of the present invention to suppress unnecessary waveguide electromagnetic field modes within the required frequency band generated in a waveguide formed in the inside of a radar transponder and secure a sufficient receiving sensitivity.

The radar transponder according to the present invention mounts amplifying means and detecting means on an antenna housing via an elastic metal body.

The elastic metal body is closely contacted with the antenna housing to form a waveguide having a volume smaller than that of the conventional one, and acts so as to make the required frequency band not higher than its cut-off frequency. By this, unnecessary waveguide electromagnetic field modes within the required band does not occur. Accordingly, unnecessary interferences applied to the amplifying means such as a FET amplifier and the like are removed, thereby allowing the primary performance of the FET amplifier concerned to be obtained and a good receiving sensitivity of the radar transponder to be obtained.

Also, the performance obtained by adjusting the amplifying means and the detecting means in a state under which the both means are mounted on a fixed mounting plate can be easily reproduced after the both means are mounted on the antenna housing.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a circuit block diagram showing a circuit configuration of a conventional radar transponder;

Fig. 2 is a partial perspective view showing a part of a springy metal wall with slits mounted on a MIC mounting plate of a transponder of an embodiment according to the present invention;

Fig. 3 is a detailed diagram showing the springy metal wall with slits shown in Fig. 2 in detail;

and

Fig. 4 and Fig. 5 are partial sectional views showing a receiving unit of the transponder of the embodiment according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 2 is a partial perspective view of a radar transponder in which a springy metal wall with slits is mounted on a MIC mounting plate. In Fig. 2, reference numeral 22 is a springy metal wall with slits as an elastic metal body which is provided at both sides on the diode direct detector 2 in the longitudinal direction and mounted on the upper part of the MIC mounting plate 21. Fig. 3 is a detailed drawing of the springy metal wall 22 with slits, and reference numeral 23 are a plenty of slits provided at the folded portion 221 of the upper side of the springy metal wall 22 with slits in order to give resilience to the metal wall.

Fig. 4 is a sectional view showing a state in which the MIC mounting plate 21 having the springy metal wall 22 with slits thereon is mounted is further mounted on an antenna housing 20, and Fig. 5 is a side sectional view of Fig. 4.

Next, the operation of Fig. 5 will be described. The radar electric wave received by a receiving antenna (not shown) is converted from the electric wave propagation mode in a waveguide composed of the antenna housing 20 and the MIC mounting plate 21, that is, the TE mode to the electric wave propagation mode in the MIC portion, that is, the TEM mode by a ridge conversion unit 24. After the mode-converted electric wave concerned is amplified by the FET amplifier connected to the ridge conversion unit 24 by soldering and the like, it is converted into a DC detected output by the diode direct detector 2. The DC detected output concerned is further amplified by the video amplifier (not shown), and the amplified output triggers the control circuit (not shown), thereby opening the transmission gate of the transmission gate circuit (not shown) and transmitting a response electric wave.

In this case, since the springy metal wall 22 with slits is provided on the both sides of the FET amplifier 16 and the diode direct detector 2 in the longitudinal direction and mounted on the MIC mounting plate 21 as shown in Fig. 2, if the metal wall 22 is assembled with the antenna housing 20 to form an unitary body as shown in Fig. 4 and Fig. 5, the springy metal wall 22 with slits is closely contacted with the antenna housing 20 by the aid of resilience based on the slits 23 to make perfect high frequency contact to the antenna housing 20 and to form a waveguide having a volume smaller than that of a conventional one. In this way, since the construction of the waveguide formed by the springy metal wall 22 with slits functions so that the required frequency band becomes not higher than the cut-off frequency, it does not generate unnecessary waveguide electromagnetic field mode at

all. Accordingly, unnecessary interferences applied to the FET amplifier 16 are removed, thereby allowing the performance inherent to the FET amplifier 16 to be obtained.

Such a radar transponder that the performances of the FET amplifier 16 and the diode direct detector 2 obtained by the adjustment after they are mounted on the MIC mounting plate 21 can be also easily reproduced after mounting them to the antenna housing 20 can be obtained.

Incidentally, in the above-mentioned embodiment, though an example in which the springy metal wall 22 with slits is mounted on the MIC mounting plate 21 with the metal wall 22 held in a state as shown in Fig. 2 is shown, the springy metal wall 22 with slits may be mounted on the antenna housing 20 with the metal wall 22 held upside down.

In the above-mentioned embodiment, the slits 23 are formed on the end of the metal wall 22. But, the gist is that the whole of the metal wall 22 has resilience. Accordingly, the metal wall 22 concerned may form slits 23 with various shapes at the central portion thereof. Further, if the metal wall 22 has resilience as a whole, a metal body implemented so as to obtain resilience using other means such as, for example, the means that the whole of the metal wall 22 is formed so as to be spring-shaped may be used without restriction to the embodiment in which slits are disposed at one portion of the metal wall concerned 22.

In the above-mentioned embodiment, though the FET amplifier 16 is used as an amplifying means, other amplifiers such as a travelling-wave tube amplifier may be employed. Furthermore, though the diode direct detector 2 is used as a detecting means, other kinds of detectors may be employed.

As described above, according to the present embodiment, since in a radar transponder having a receiving unit equipped with an amplifying means and a detecting means, the radar transponder is configurated so as to mount its amplifying means and detecting means via a metal body having resilience on the antenna housing, unnecessary waveguide electromagnetic field modes within the band are removed. This leads to the result that inherent performance as an amplifying means, for example, that of the FET amplifier can be obtained and a radar transponder having a good receiving sensitivity can be obtained. Also, this leads to the result that there can be obtained such a radar transponder as the inherent performances as an amplifying means and as a detecting means, for example, those of the FET amplifier and of the diode direct detector 2 obtained by adjusting the both means on the fixed mounting plate can be easily reproduced after mounting those means on

the antenna housing.

Claims

1. A radar transponder comprising a receiving antenna (1) for receiving an electric wave emitted from a radar, an amplifying means (16) for amplifying said received electric wave, a detecting means (2) for detecting the output of the amplifying means, a video amplifier (3) for amplifying the output of the detecting means, a control circuit (4) for producing a signal which determines the transmission time of the transmitting electric wave using the output signal of the video amplifier (3) as a trigger, a transmission gate circuit (5) for producing transmission gate pulses in accordance with the output of the control circuit (4), a sweep signal generator (6) for generating saw-tooth voltage which wave form consists of a required number of saw-tooth pulses in the period during which said transmission gate pulses are generated, a microwave oscillator circuit (7) for generating a frequency swept signal having a regular frequency based on said saw-tooth voltage in the period during which said transmission gate pulses are generated, and a transmitting antenna (8) for emitting said frequency swept signal into space, characterized in that said amplifying means (16) and detecting means (2) are mounted via a metal body (22) having resilience on an antenna housing (20).
2. A radar transponder according to claim 1, wherein said metal body is a springy metal wall (22) with slits (23) at its end portion.
3. A radar transponder according to claim 1, wherein said metal body is a springy metal wall (22) with slits (23) at its central portion.
4. A radar transponder according to claim 1 to claim 3, wherein said amplifying means (16) and detecting means (2) are integrated in a microwave integrated circuit.

Patentansprüche

1. Radar-Transponder mit einer Empfangsantenne (1) zum Empfang einer von einer Radaranlage ausgesendeten elektrischen Welle, mit Verstärkungsmitteln (16) zum Verstärken der elektrischen Welle, mit Detektormitteln (2) zum Gleichrichten des Ausgangssignals der Verstärkungsmittel, mit einem Video-Verstärker (3) zum Verstärken des Ausgangssignals der Detektormittel, mit einer Steuerschaltung (4) zum Erzeugen

5 eines Signals, das die Sendezeit der gesendeten elektrischen Welle bestimmt und das Ausgangssignal des Video-Verstärkers (3) als Triggersignal verwendet, mit einer Sendegatterschaltung (5) zum Erzeugen von Sendegatterimpulsen in Übereinstimmung mit dem Ausgangssignal der Steuerschaltung (4),
10 mit einem Wobbelgenerator (6) zum Erzeugen einer Sägezahnspannung, deren Wellenform in dem Zeitraum, während dem die Sendegatterimpulse erzeugt werden, aus einer erforderlichen Anzahl von Sägezahnimpulsen besteht, mit einer Mikrowellen-Oszillatorschaltung (7) zum Erzeugen eines in der Frequenz gewobbelten Signals, dessen regelmäßige Frequenz während des Zeitraums, in dem die Sendegatterimpulse erzeugt werden, von der Sägezahnspannung gesteuert wird, und
15 mit einer Sendeantenne (8) zum Aussenden des in der Frequenz gewobbelten Signals, dadurch gekennzeichnet,
20 daß die Verstärkungsmittel (16) und die Detektormittel (2) über einen federnden Metallkörper (22) am Antennengehäuse (20) befestigt sind.

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2. Radar-Transponder nach Anspruch 1, bei dem der Metallkörper eine federnde Metallwand (22) mit Schlitten (23) in seinem Endabschnitt ist.
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3. Radar-Transponder nach Anspruch 1, bei dem der Metallkörper eine federnde Metallwand (22) mit Schlitten (23) in ihrem Mittelteil ist.
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4. Radar-Transponder nach den Ansprüchen 1 bis 3, bei dem die Verstärkungsmittel (16) und Detektormittel (2) in einen Mikrowellen-IC integriert sind.

Revendications

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1. Transpondeur radar comprenant une antenne de réception (1) destinée à recevoir une onde électrique émise par un radar, un moyen d'amplification (16) destiné à amplifier ladite onde électrique reçue, un moyen de détection (2) destiné à détecter la sortie du moyen d'amplification, un amplificateur vidéo (3) destiné à amplifier la sortie du moyen de détection, un circuit de commande (4) destiné à produire un signal qui détermine le temps d'émission de l'onde électrique émise en utilisant le signal de sortie de l'amplificateur vidéo (3) comme déclencheur, un circuit porte d'émission (5) destiné à produire des impulsions de porte d'émission en accord avec la sortie du circuit de commande (4), un générateur (6) de signaux de balayage destiné à engendrer une tension

en dents de scie dont la forme d'onde est composée d'un nombre requis d'impulsions en dents de scie dans la période dans laquelle lesdites impulsions de porte d'émission sont engendrées, un circuit oscillateur micro-onde (7) destiné à engendrer un signal balayé par fréquence ayant une fréquence régulière basée sur ladite tension en dents de scie pendant la période dans laquelle lesdites impulsions de porte d'émission sont engendrées, et une antenne d'émission (8) destinée à émettre ledit signal balayé en fréquence dans l'espace, caractérisé en ce que ledit moyen d'amplification (16) et ledit moyen de détection (2) sont montés sur un boîtier (20) d'antenne par l'intermédiaire d'un corps métallique (22) présentant de l'élasticité.

2. Transpondeur radar selon la revendication 1, dans lequel ledit corps métallique est une paroi en métal élastique (22) munie de fentes (23) dans sa portion terminale. 20

3. Transpondeur radar selon la revendication 1, dans lequel ledit corps métallique est une paroi (22) en métal élastique munie de fentes (23) dans sa portion centrale. 25

4. Transpondeur radar selon les revendications 1 à 3, dans lequel ledit moyen d'amplification (16) et ledit moyen de détection (2) sont intégrés dans un circuit intégré micro-onde. 30

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FIG. 1

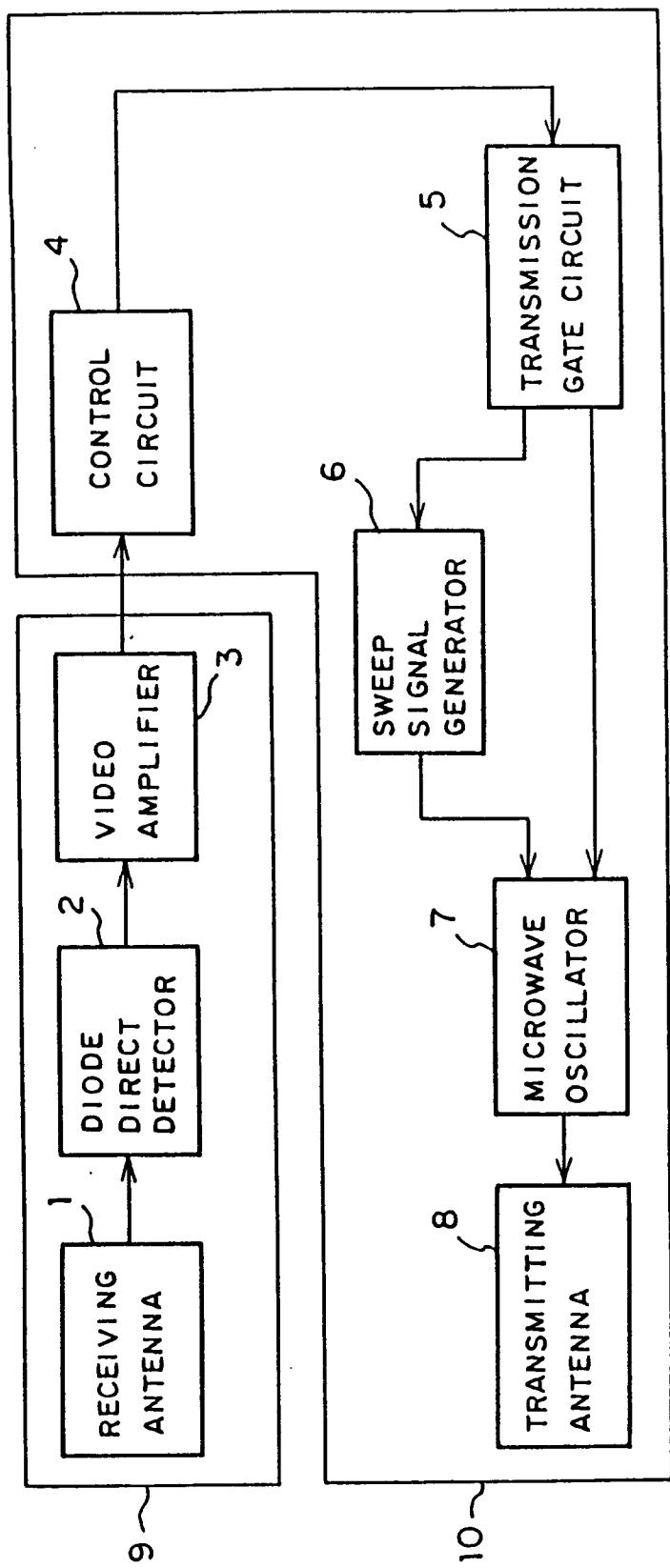


FIG. 2

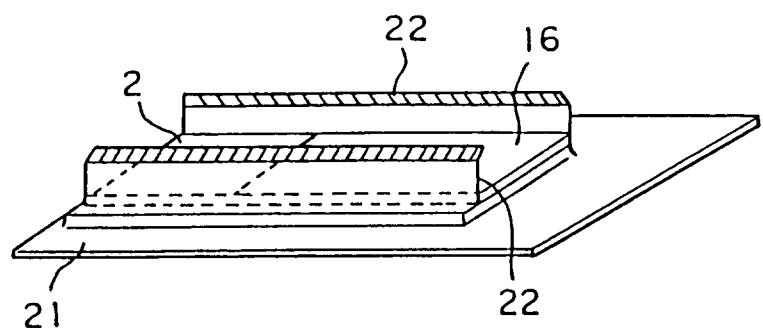


FIG. 3

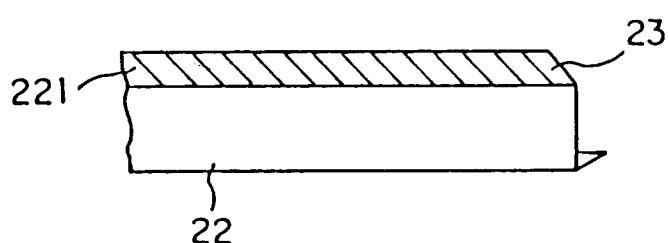


FIG. 4

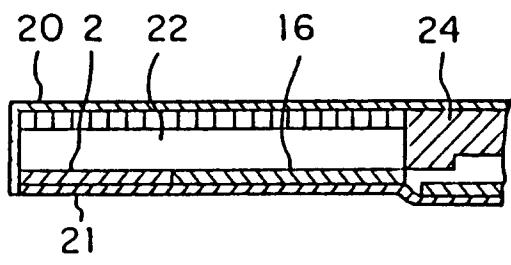


FIG. 5

